THE RADIOACTIVE DECAY OF Y^{87} AND Sr^{87}

BY

LLOYD GODFREY MANN

B.S., Worcester Polytechnic Institute, 1944
M.S., University of Illinois, 1947

AN ABSTRACT OF A THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN PHYSICS
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ACKNOWLEDGEMENTS

I would like to express my appreciation to Professors P. Axel and M. Goldhaber for suggesting the problem and for constant guidance. I am particularly indebted to Professor Axel for his generous assistance in taking data on the short lived sources and in evaluating the results.

Professor W. E. Meyerhof was extremely generous with discussions and advice regarding the general problems of beta ray spectroscopy. I would like to thank Professor F. Metzger for his very active interest in the problem and for the use of his equipment and help in carrying out the experiments with sodium iodide crystals. He has been very helpful.

I am indebted to Mr. Jacque Ovadia for help in taking data from the short lived sources.

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THE RADIOACTIVE DECAY OF Y^{87} AND SR^{87}

The work that is described in the following thesis was done to obtain data on the decay of Y^{87} and Sr^{87} which can be used to test the theories of nuclear isomerism and shell structure. In order to evaluate these theories complete and accurate information is needed on the decay of many isotopes. The Y^{87} and Sr^{87} isotopes can be expected to supply especially useful information in an investigation of this type.

A double magnetic lens beta ray spectrometer was constructed for use in this type of problem. Performance characteristics include 2.5 percent resolution and one percent transmission. Thin window Geiger counters have been developed which permit work down to energies of 10 kev. Other equipment and techniques used include coincidence counting, absorption, and the use of sodium iodide crystals in coincidence for the detection of gamma rays.

A decay scheme which postulates one unobserved transition is proposed for these yttrium and strontium isotopes. The main features of this decay scheme are well established and include the assignment of two gamma-rays to Sr^{87}. One is the relatively well known 390 kev gamma ray from the 2.7 hour state in strontium and the other is a 486 kev gamma which feeds into this state and has previously not been fitted into a decay scheme. The energies of both gamma rays have been measured in the spectrometer to 0.5 percent accuracy. The two yttrium states decay by K capture and weak positron spectra to the excited states of strontium, and an unobserved isomeric transition of very low energy has been postulated between these states. Half lives have been determined as 80 ± 1 and 14 ± 1 hours in agreement with other investigators.

Conversion coefficients of $0.29 \pm .04$ for the 390 kev transition and 0.0036 for the 486 kev transition have been determined. The K/L ratio of $6.9 \pm .4$ for the 390 kev

transition has been measured. These results are used to determine multipole orders from Rose's tables in order to assign spins and parities and check theories of shell structure and isomerism. Unfortunately the conversion coefficient measurements were not accurate enough to determine uniquely the multipole orders.

VITA

Lloyd Godfrey Mann was born in Sterling, Mass., on July 2, 1922. He attended Worcester Polytechnic Institute in Worcester, Mass., from September, 1940 to February, 1944, when he received the Bachelor of Science degree in Physics.

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